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Auto Controlling Smart Movable Road Divider and Clearance Ambulance Path using IOT

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ABSTRACT: Traffic congestion and emergency vehicle delays are major challenges in urban transportation, often leading to critical consequences. This project proposes an **Auto Controlling Smart Movable Road Divider and Clearance Ambulance Path Using IoT**, which aims to enhance traffic management and ensure the swift movement of emergency vehicles. The system employs **Internet of Things (IoT) technology** to monitor real-time traffic density and dynamically adjust road dividers. Using **sensors, RFID technology** and smart dividers reposition themselves to create additional lanes for high-traffic areas or to provide a dedicated pathway for ambulances. Key components include **ultrasonic sensors, infrared sensors, servo motors, microcontrollers Arduino, and wireless communication modules**. These components collect and process traffic data, enabling the system to make automated adjustments for optimizing lane usage and minimizing congestion. For emergency vehicle clearance, **RFID-based identification** allows ambulances to communicate with the system in advance. This triggers an automatic realignment of road dividers while also **modifying traffic signals dynamically** to ensure a smooth passage by turning green in the ambulance's direction and stopping traffic in other directions. By integrating **IoT Automation**, this system significantly reduces emergency response times, alleviates congestion, and paves the way for a more intelligent and efficient traffic management framework.

KEYWORDS: Traffic Congestion, Clearance Ambulance Path, Internet of Things (IoT), Dynamic Road Divider Adjustment, RFID Technology, Automated Traffic Management.

I. INTRODUCTION

Effective emergency medical services are crucial for saving lives in today's fast-paced world. One innovative approach to enhance the efficiency of ambulance services is the introduction of **Clearance Ambulance Paths** using a **Smart Movable Road Divider System**. In the past, roads were designed with only one lane, leading to significant problems and inefficiencies in reaching destinations due to traffic congestion. There were also limited facilities, security measures, and flexibility. Although two and later four lanes were added over time, these changes still failed to resolve traffic issues effectively. Several studies have proposed using **IoT and embedded systems** to control traffic congestion with **infrared sensors** that detect traffic flow. However, such systems struggle with accurate traffic recognition and depend on expensive, high-maintenance components. As the number of vehicles continues to grow daily, the road infrastructure remains largely unchanged, making it ill-equipped to adapt to unpredictable delays, traffic jams, and accidents. Traffic congestion remains one of the biggest challenges in modern society, especially for **emergency vehicles** like ambulances. These vehicles often get stuck in traffic for extended periods, posing serious risks to patients' lives. This paper proposes a solution: a **movable road divider** that dynamically adjusts based on traffic conditions. Real-time traffic data, collected through IoT and camera-based vision, is used to create a responsive connection between traffic flow and the divider's position. The system recognizes two traffic phases: incoming and

outgoing. During peak hours, one direction may experience heavier traffic than the other. When vehicles accumulate in large numbers, traffic jams occur. To avoid such congestion, a **smart movable divider**, equipped with RFID tags and controlled through traffic density data, automatically shifts lanes to balance the flow. The divider is fitted with **infrared sensors** to detect obstacles and prevent collisions, ensuring safe operation without causing damage. This system prioritizes the movement of emergency vehicles, allowing them to pass swiftly.

II. LITERATURE SURVEY

The literature survey aims to explore existing research and technological advancements in the field of intelligent traffic management and emergency vehicle clearance systems. Several research works have focused on addressing traffic congestion and improving emergency vehicle movement using smart technologies. Over the years, numerous studies have addressed the challenges of traffic congestion, especially in urban areas, and its impact on emergency response times. Traditional methods, such as traffic lights and static lane divisions, have proven to be inadequate in handling dynamic traffic conditions. Recent research has focused on the use of IoT, embedded systems, machine vision, and artificial intelligence to develop smarter and more adaptive traffic solutions. This section reviews various methodologies, technologies, and innovations proposed by researchers to tackle traffic-related issues, highlighting their advantages, limitations, and scope for future improvements.

A study was conducted on Western express road close to Goregaon, Mumbai, in Reference [1], a 10-lane road was chosen once noting the congestion points. The western express highway was so selected to understand the current traffic scenario for long distances. A survey was carried out for a span of 7.00 am to 9.00 pm, data collected from the survey was no. of vehicle passing a point, speed of vehicle and concluded by saying speed of the vehicle reduces significantly during the peak hours.

Reference [2] Mrs. G. Anitha Chowdary, N. Ganesh, M. Venu, M. Ranjith Kumar (2023) proposed a system that uses a **Smart Movable Road Divider** to dynamically shift lanes based on traffic demand. The study highlights that static dividers are inflexible, leading to inefficient use of road space during peak hours. By reallocating lanes to match the direction of traffic flow, this solution significantly reduces time and fuel consumption, thereby enhancing overall urban mobility. (IJCRT, Vol. 11, Issue 4).

Reference [3] Subhashitha D, Dr. Mukthi S. L designed a smart movable divider system that operates based on traffic density. The system utilizes **RFID technology** for ambulance detection, enabling automatic signal control and **lane clearance** for emergency vehicles. The project also includes features to detect signal violations, thereby enhancing road discipline and safety. (IJERECE, Vol. 8, Issue 7).

Reference [4] Sandeep S. Baragoor, Thanmai N, Sandeep S. Javaller (2021) addressed the challenges posed by fixed-lane traffic systems in metropolitan cities. The paper emphasizes the growing mismatch between rising vehicle numbers and static road infrastructure. It proposes a dynamic lane allocation system using smart dividers to ensure better utilization of available space and reduce congestion during peak times. (IJERT, Vol. 10, Issue 07).

Reference [5] Sowjanya K. N, Nikhil Jamadagni H. M, K. Unnimaya, Bhavana G implemented a smart road divider system controlled by IR sensors and cloud-based **IoT platforms**. The system dynamically adjusts lane allocation based on real-time traffic density. An RF module is used to detect ambulances and **manage traffic signals** accordingly, providing a **dedicated path** for emergency vehicles. A prototype was developed to test congestion control and driver alert features.

Urban roads often face uneven traffic flow throughout the day—commercial areas see heavy congestion in the mornings, while residential routes are more crowded in the evenings. This imbalance leaves one side underutilized, wasting valuable road space. To address this, a smart movable road divider **dynamically adjusts lane** allocation based on real-time traffic data. Depending on traffic density, the system decides whether to keep the divider in place, shift it left, or shift it right. The aim is to **reduce congestion** while minimizing unnecessary movements to preserve the mechanism. Vehicle density on both sides is monitored and displayed on an LCD, and the divider moves accordingly. An ultrasonic sensor ensures safety by **detecting any obstacles** in its path, pausing movement if needed to prevent collisions.

III. METHODOLOGY

The proposed system where smart movable road divider system relies on real-time traffic monitoring using sensors like cameras, IR sensors, ultrasonic sensors, and inductive loops to track vehicle flow and density on both sides of the road. This data is sent to a central control unit, where algorithms and machine learning techniques analyse traffic volume, speed, and emergency presence to determine optimal barrier positioning. A reliable mechanism—powered by hydraulic, pneumatic, or electric actuators—then adjusts the median smoothly and safely. The system also detects emergency vehicles using sensors or communication modules and automatically adjusts the divider to provide a clear path. All components are integrated for seamless communication with traffic management canters and emergency services. Built-in security and redundancy ensure safe, uninterrupted operation. A user-friendly interface enables authorized personnel to monitor traffic conditions and system status in real time.

1. Measuring traffic density using IR sensor:

- **Measure traffic density** by detecting reflected infrared rays from vehicles on both sides.
- **Reflection time is analysed** to calculate traffic percentage, indicating vehicle count and movement speed.
- **Divider shifts direction accordingly**, creating extra lanes for high-density traffic, shown via LCD alerts.

2. Fixing and processing the data to move the barrier:

- Traffic density varies throughout the day, causing congestion in different directions based on time.
- **Divider movement decisions** are based on traffic density, with three possible actions: no movement, left, right.
- **Infrared sensors** detect obstacles, ensuring safe movement of the divider along the road lanes.

3. Detecting obstacles while moving the divider using ultrasonic sensors:

- Ultrasonic sensors detect vehicles in the divider's path and measure distance to detect obstacles.
- If an obstacle is detected, the divider stops and signals vehicles to clear the lane.
- Once the lane is clear, the divider resumes movement until it reaches its destination.

4. Emergency Vehicle Detection and Prioritization:

- **RFID Tags and Readers:** Emergency vehicles use RFID tags, detected by readers, to prioritize passage.
- **Dedicated Lane Detection:** Image processing analyses footage to detect emergency lanes, prioritizing vehicles in these lanes.

5. System Integration and Communication:

- **Centralized Communication Hub:** acts as the system's core, relaying data between all connected components efficiently.
- **Networking Infrastructure:** Enables secure, real-time communication among components for coordinated traffic management.

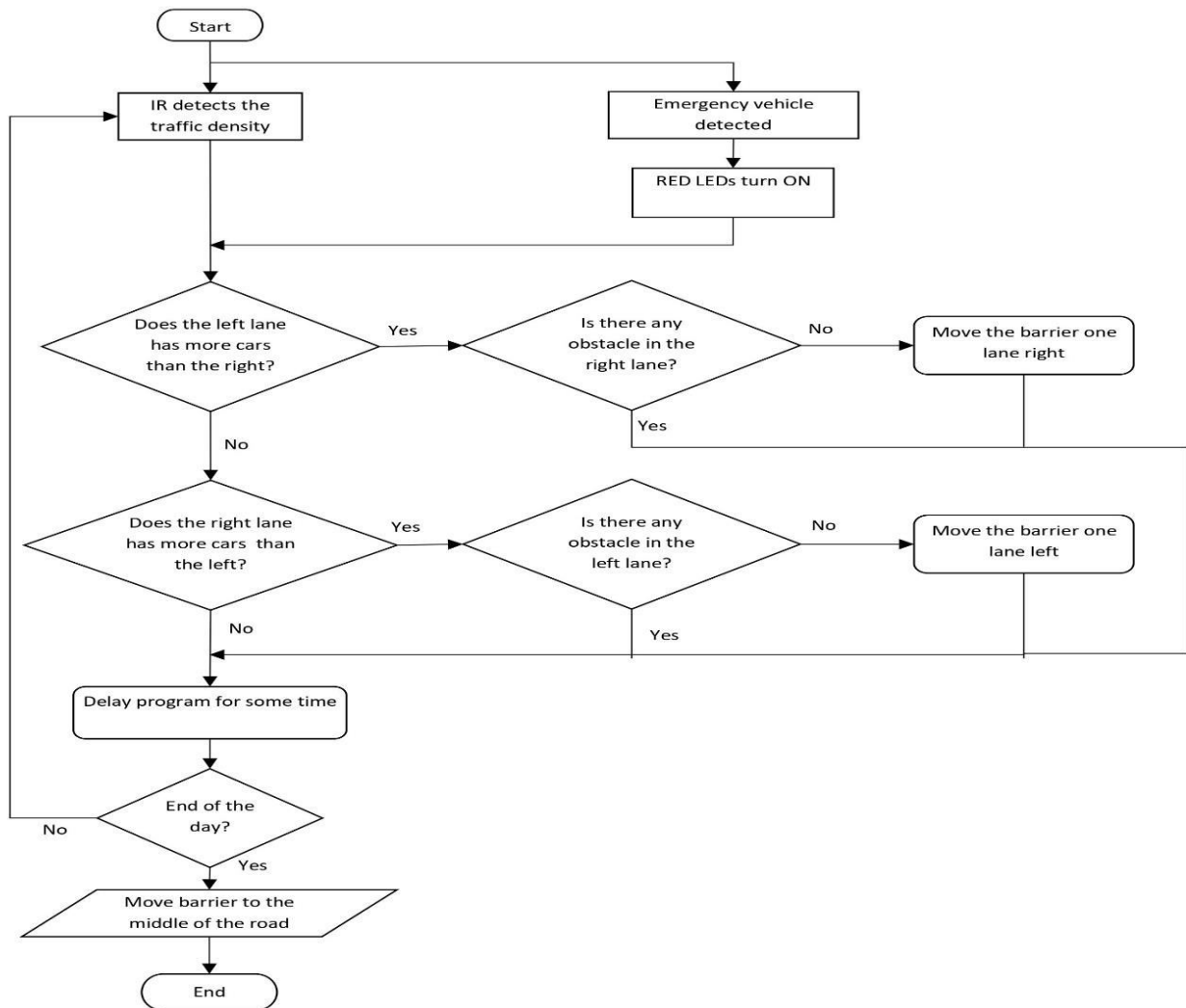
6. Security and Redundancy:

- **Multi-layered Security Measures:** Prevent unauthorized access and cyber threats through strong, layered protection protocols.
- **Redundant Components:** Backup systems ensure uninterrupted function during primary component failure or system errors.
- **Regular Updates and Maintenance:** Routine checks and updates keep the system secure, stable, and up-to-date.

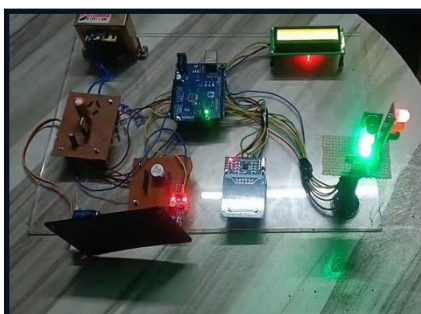
Short Summary:

- Studied traffic congestion and lane utilization issues.
- Used IR, ultrasonic, RFID, and cameras for real-time traffic data collection.
- Built central control logic with machine learning for dynamic divider movement.
- Designed safe movement mechanism with obstacle detection using ultrasonic sensors.
- Integrated emergency vehicle detection and prioritized their passage.

- Developed frontend interface for real-time monitoring and control.
- Focused on security, redundancy, and seamless system communication.
- Tested system functionality and safety measures.
- Provided complete documentation for system use and maintenance



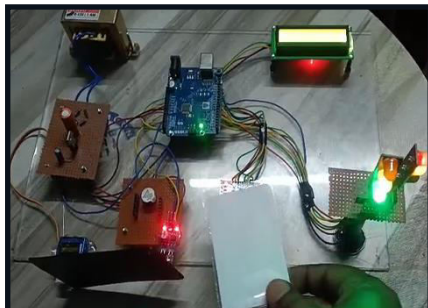
LCD Display



Traffic Controlling



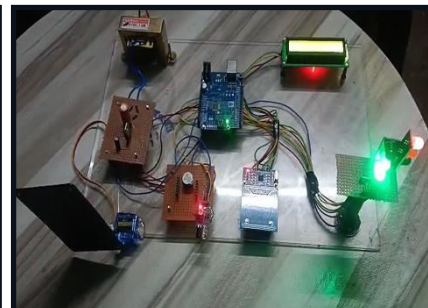
Waiting for Ambulance



Ambulance With RFID-Tag Detected



Lcd Display Show Detail



Path Clearance for Ambulance

IV. EXPERIMENTAL RESULTS

The Experiment was done on Smart Movable Road Divider with Ambulance Path Clearance and Traffic controlling.

S.NO	PARAMETER	RESULT
01	ANALYSE TRAFFIC DENSITY	DENSITY ANALYSED SUCCESSFULLY
02	AMBULANCE WITH RFID – TAG FOR PATH CLEARANCE	DETECTED RFID-TAG BY DIVIDER
03	DIVIDER DETECT RFID – TAG FROM AMBULANCE BY ULTRA-SONIC RAY	DETECTED RFID-TAG BY DIVIDER
04	DIVIDER CLEAR PATH BY USING INFRARED RAY FOR AVOIDING COLLISION	PATH CLEARANCE, AVOID COLLISION
05	AMBULANCE PATH CLEARANCE	SUCCESSFUL
06	DIVIDER BACK TO NORMAL POSITION USING INFRARED RAY FOR AVOIDING COLLISION	BACK TO NORMAL POSITION SUCCESSFULLY
07	LCD DISPLAY SHOW EVERY DETAILS FROM START TO END	DETAILS SHOWN FROM START TO END

V. CONCLUSION

The smart movable road divider system, titled Auto Controlling Smart Movable Road Divider and Clearance Ambulance Path Using IoTsystem successfully addresses urban traffic congestion by dynamically reallocating road space based on real-time traffic density. Utilizing sensors such as IR, ultrasonic, RFID, the system monitors vehicle flow and ensures safe divider movement with obstacle detection. Emergency vehicles are prioritized through automatic path clearance, enhancing response time. Centralized control, seamless communication, and a user-friendly interface enable efficient monitoring and operation. Built-in security and redundancy ensure reliable, uninterrupted performance. This intelligent system optimizes traffic flow, reduces delays, and enhances road safety, offering a scalable and innovative solution to modern traffic management challenges.

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